

16. Review of Mortality Rates and Report on the Deaths occurring in the Society's Gardens during the Year 1938. By Brevet-Colonel A. E. HAMERTON, C.M.G., D.S.O., F.Z.S., late R.A.M.C.

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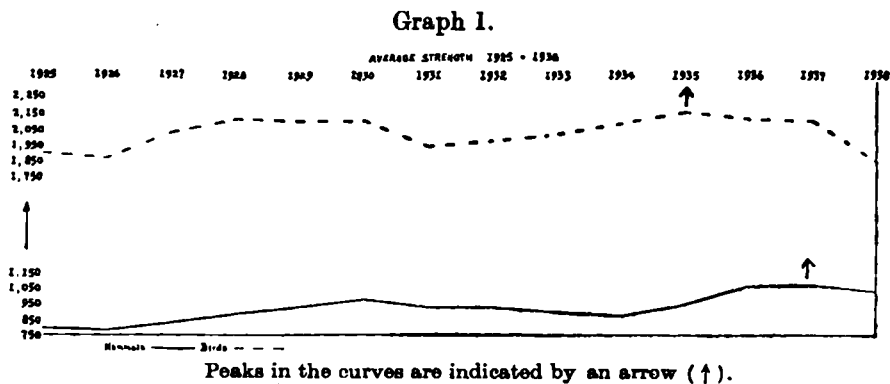
(Graphs 1-9.)

Before proceeding with the records of post-mortem examinations on animals that died during 1938, I propose to review the facts and figures regarding the causes of death in the Society's Menagerie during the last fourteen consecutive years. It is hoped that we may obtain thereby some indication as to whether the "Health and Loss" account has followed a favourable course during the period under review.

Statistical data regarding the annual census and mortality rates among Mammals and Birds have been recorded since 1925, when the investigation of disease by modern scientific methods and the application of the principles of hygiene were initiated by my predecessor, Dr. Harold Scott, and by our Superintendent, Dr. Vevers.

It may now be of interest if we examine the figures shown in the form of graphs representing the fluctuations in the numerical strength of the Menagerie—the mortality rates and the incidence of the most destructive diseases.

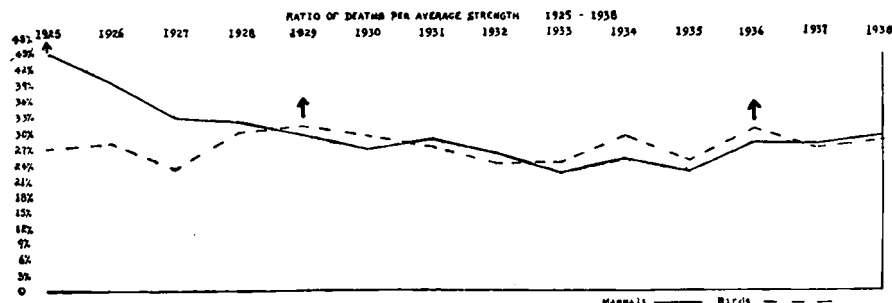
Graph 1 represents the approximate annual variations in the stock of Mammals and Birds over the period 1925-1938 inclusive. (Mammals continuous line, ————, Birds interrupted line, - - - - -, extending from the



figures on the left.) It will be seen that the stock of Mammals was lowest, i. e., 789 in 1925, and rose to a maximum of 1069 in 1937—and has been maintained at about that level. The stock of Birds rose from 1905 in 1925 to a maximum of 2152 in 1935.

In graph 2 we have for comparison a curve representing the ratio of deaths per average strength for the same period. It will be seen that, since the highest

Graph 2.



death rate, viz., 45.3 per cent. among Mammals in 1925, there has been a progressive fall until we reach a death rate of 22.7 per cent. in 1935, and then there is a gradual rise to 29.7 per cent. in 1938.

On the whole this record may be considered satisfactory and is undoubtedly attributable to improvements in the sanitation, feeding, and general care of the Mammals during this period.

The curve for the Birds (lowest, i. e., 23.3 per cent. in 1927, peak 31.5 per cent. in 1929/36) is not satisfactory, and shows no real improvement.

In Table A there is recorded in tabular form the yearly bill of mortality for the decade 1929-1938 in which the common death dealing diseases are grouped in order of virulence.

The number of deaths and the ratio per total fatalities are stated in the column opposite each disease group.

The onus of diagnosis during the decade has remained with one doctor, and the causes of death have been registered in accordance with the 'Official Nomenclature of Diseases,' and 'The International List of Causes of Death,' published by H.M. Stationery Office. It is hoped, therefore, that uniformity has been attained in grouping the causes of death for statistical purposes.

In certain cases where diagnosis has been difficult I have had the advantage of gratuitous consultations with specialists in parasitology, bacteriology, virus diseases, biochemistry, radiology, dental diseases, and other distinctive branches of pathology. The help so freely given has sometimes required special laboratory investigation of a highly technical character, and has been of great advantage to the Society.

To return to the table, I would draw attention to the prevalence of Diseases of the Respiratory System among Mammals and Reptiles, and the mortality from Diseases of the Digestive System among Birds; also to Diseases of the Urinary System—mainly inflammatory and degenerative forms of nephritis—which stand third in order of destruction among our stock of Birds. Diseases of the Circulatory System (mainly cardio-vascular degeneration and endocarditis associated with focal sepsis) are amongst the most fatal avian disorders. Diseases of the Heart, Arteries, and Kidneys occur most frequently in elderly birds, and are to be expected in creatures that throughout life maintain the highest temperature and metabolism of all living things.

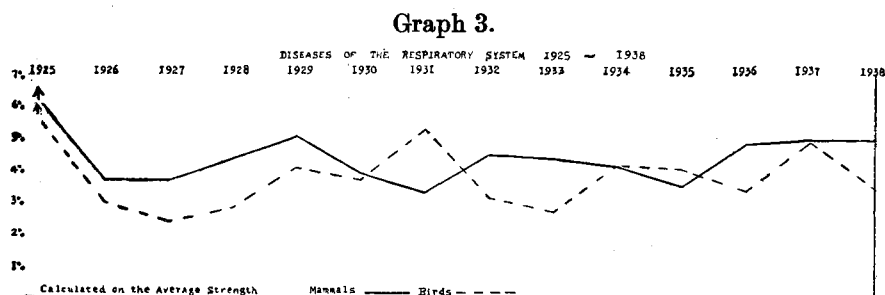
Deaths due to *Inanition*, *Marasmus*, and *Abiotrophy*, conditions that

TABLE A.—Cause of Death and Mortality Rates for the Decade 1929–1938.

DISEASE.	MAMMALS.		BIRDS.		REPTILES.		TOTALS.	
	Total deaths.	Per cent.	Total deaths.	Per cent.	Total deaths.	Per cent.	Total deaths.	Per cent.
Diseases of the Respiratory System.....	424	16.3	784	13.8	473	23.1	1681	16.35
Diseases of the Digestive System.....	257	10.0	1001	17.7	226	11.0	1484	14.43
Inanition, Marasmus, Abiotrophy.....	76	2.9	145	2.5	301	14.7	522	5.08
Diseases due to Animal Parasites.....	72	2.8	114	2.0	193	9.4	379	3.69
Diseases of the Urinary System.....	55	2.1	249	5.1	22	1.1	326	3.18
Diseases of the Blood and Circulatory System.....	51	2.0	228	4.0	28	1.4	305	2.97
Mycosis.....	11	.4	231	4.1	38	1.8	280	2.73
Disorders of Nutrition and Metabolism.....	205	7.9	53	.9	9	.4	267	2.6
Tuberculosis.....	99	3.8	189	3.3	49	2.4	337	3.26
Diseases of the Generative System.....	21	.9	139	2.4	80	3.9	240	2.34
Diseases of the Liver.....	66	2.5	132	2.3	27	1.3	225	2.19
Diseases of the Skin and Areolar Tissues.....	35	1.4	57	1.0	96	4.7	218	2.12
Tumours and Cysts.....	23	1.0	7	.1	4	.2	59	.58
Diseases of the Nervous System.....	21	.9	6	.1	1	.05	30	.3
Diseases of the Endocrine Glands.....	14	.3	10	.1	1	.05	25	.25
Diseases of the Joints.....	1	.04	—	—	—	—	1	.01
Injuries and Accidents.....	548	21.1	1278	22.6	177	8.7	2003	19.48
Destroyed unfit for Exhibition on Account of Deformities, Old Injuries, Blindness, and Old Age.....	414	16.0	722	12.4	—	—	1136	11.05
Cause of Death not ascertained.....	135	5.2	310	5.3	324	15.8	769	7.49
Totals.....	2593	100.0	5673	100.0	2049	100.0	10315	100.0

may not be associated with gross pathological lesions, cause serious losses during the period of acclimatization—*i. e.*, within six months of arrival.

The incidence of Diseases of the Respiratory System over the period 1925-1938 is represented in graph 3.

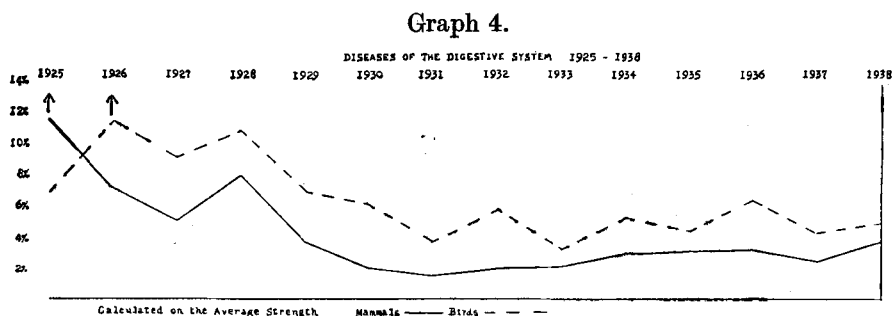


The highest figures for Mammals, viz., 6.1 per cent., and that for Birds, 5.5 per cent., occurred in 1925.

The lowest figures for Mammals was 3.3 per cent. in 1931 and for Birds 2.4 per cent. in 1927.

The maladies included in this group are mainly climatic in origin, and cannot be combated except in certain species, such as Anthropoid Apes, which are now segregated from actual contact with the public and protected by glass screens from droplet infection.

Graph 4 illustrates the mortality rate from Diseases of the Digestive System over a 14 year period.



In 1925 the peak figure of 11.5 per cent. for Mammals occurred during an epizootic of enteritis among a colony of Hamadryad Baboons on Monkey Hill. The disease was caused by infection with *Bacillus Aertrycke*, one of the food poisoning microbes, and caused many losses.

The insanitary old Monkey House was evacuated early in 1926; the pathological department was modernized and utilized in guiding the application of the principles of hygiene in housing, feeding, and preventive treatment of animals, with the result that can be seen in the subsequent tracing of the graph during the period under review.

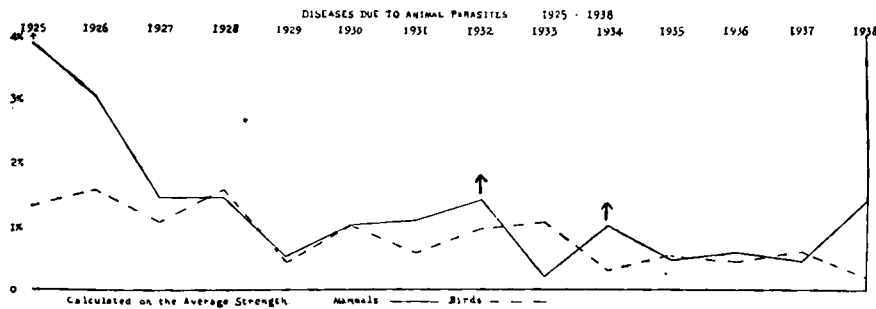
The rise in the death rate of Mammals and Birds during 1928 coincided with the highest recorded attendances in the Gardens, viz., over 2½ million

visitors in that year, with consequent overcrowding of the houses and over-feeding of certain animals.

The new Bird House was opened in Spring 1929, and the new Parrot House in 1930, and was followed by a notable decline in the mortality amongst birds.

Graph 5 shows the incidence of deaths due to Animal Parasites, mainly helminths, which caused serious losses among Mammals in 1925-1926. Since

Graph 5.



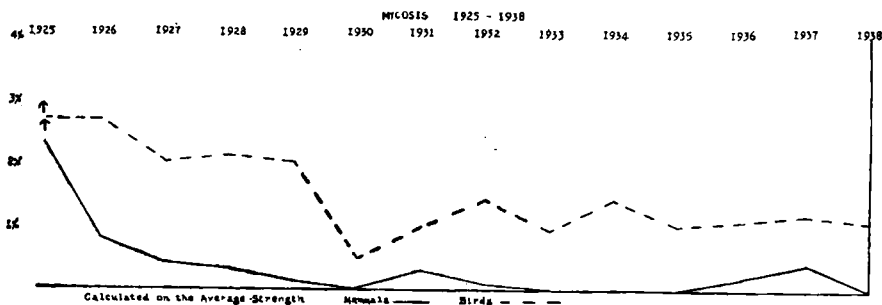
when, preventive measures—especially quarantine, during the period of which infestation is detected and treated—have notably reduced the mortality from this cause.

During the financially prosperous years 1927/28/29 money was available for carrying out frequently such essential antihelminthic measures as reconditioning, liming, and returfing the contaminated ground in dens and paddocks.

Periods of financial stringency are reflected in peaks for 1932, 1934. The upward trend during 1938 is mainly accounted for by the prevalence of Pulmonary Acariasis in the monkey colony on Monkey Hill.

Graph 6 shows a marked decline in the incidence of avian mycosis especially amongst the most susceptible species, viz., Penguins and Parrots.

Graph 6.



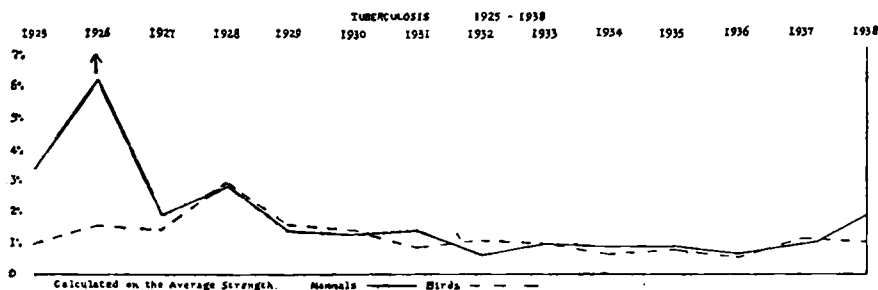
The old Penguin pond was filled in during 1929 and the birds transferred to the Mappin Terrace pond, and the new Penguin pond was occupied in 1933. Among Parrots, mycosis has been a rare disease since the birds were transferred to the new Parrot House in 1930.

Mycosis is an uncommon disease amongst our Mammals—but was prevalent in epizootic form (*Streptothricosis nocardia*) amongst an infected herd of

Wallabies presented to the Gardens in 1925. They all died of the disease, and only a few isolated sporadic cases have since occurred in Mammals.

The successful application of hygienic measures is again illustrated by graph 7 showing the decline of mammalian tuberculosis.

Graph 7.



In 1926 we lost 24 Primates, including 2 valuable Anthropoid Apes, from this disease.

The conspicuous fall in tuberculosis mortality since 1926 is mainly due to the virtual elimination of the infection from our collection of Primates, though imported cases occasionally occur, but are detected and destroyed in quarantine. All orders of Mammals, however, have shared in the reduction, except the family Bovidae, in which, owing to their naturally high degree of susceptibility, the dilapidated and insanitary condition of their quarters, and the frequent importation of infected bovines from Oriental Zoos, the infection continues to increase amongst these animals and remains the most devastating disease amongst our ruminants, as indicated by the upward trend during the last two years.

The incidence of tuberculosis among Birds is difficult to combat and shows no improvement.

Table B shows the number of deaths from tuberculosis in Mammals, Birds, and Reptiles since 1925.

TABLE B.—TUBERCULOSIS.

Year.	MAMMALS.	AVES.	REPTILES.	Percentage of all deaths.
	%.	%.	%.	%.
1925.....	26 or 7.2	18 or 3.4	3 or .9	47 or 3.9
1926.....	48 or 15.1	28 or 5.3	3 or 1.0	79 or 6.8
1927.....	16 or 5.7	29 or 6.1	4 or 1.4	49 or 4.7
1928.....	24 or 8.3	60 or 9.4	1 or .4	85 or 7.1
1929.....	12 or 4.3	29 or 4.6	3 or .8	44 or 3.4
1930.....	12 or 4.5	26 or 4.4	4 or 1.1	42 or 3.5
1931.....	12 or 4.4	15 or 2.7	1 or .5	28 or 2.8
1932.....	6 or 2.4	20 or 4.1	5 or 2.7	31 or 3.4
1933.....	8 or 3.4	18 or 3.5	4 or 1.8	30 or 3.2
1934.....	7 or 3.1	13 or 2.1	5 or 2.1	25 or 2.3
1935.....	7 or 3.2	16 or 2.9	5 or 3.3	28 or 3.9
1936.....	6 or 2.0	11 or 1.6	5 or 3.1	22 or 2.0
1937.....	10 or 3.3	22 or 3.9	4 or 2.1	36 or 3.4
1938.....	19 or 6.8	19 or 3.5	13 or 11.8	51 or 5.4
Totals	213 or 5.5	324 or 4.2	60 or 2.4	597 or 4.0

Table C shows the distribution of the disease amongst the various families of Mammals.

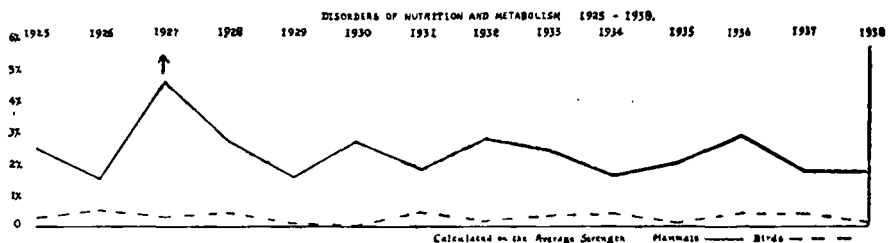
TABLE C.—Incidence of Tuberculosis amongst Mammals, 1928–1938.

	Years.											Totals.
	1928.	1929.	1930.	1931.	1932.	1933.	1934.	1935.	1936.	1937.	1938.	
Bovidae (Oxen, Antelopes)	5	2	4	2	4	1	2	2	1	4	14	41
Catarrhini (Old World Monkeys)	6	0	1	1	0	2	1	2	1	2	4	20
Cervidae (Deer)	5	4	2	3	0	0	0	0	1	0	0	15
Platyrrhini (New World Monkeys)	0	1	1	0	0	0	3	0	0	0	0	6
Platyrrhini (Hapalidae, Marmoset)	0	0	0	0	0	0	0	0	0	0	1	
Ursidae (Bears)	0	0	2	2	1	0	0	0	0	0	0	5
Pongidae (Anthropoid Apes)	3	1	0	0	0	0	0	0	0	0	0	4
Procyonidae (Coatis, Raccoons)	0	0	0	0	0	3	0	0	1	0	0	4
Tapiridae (Tapirs)	3	0	0	0	0	0	0	0	0	0	0	3
Suidae (Swine)	1	0	0	0	0	0	0	1	1	0	0	3
Viverridae (Civets and Mongoose)	1	0	0	0	0	1	1	0	0	0	0	3
Felidae (Tiger, Jaguar)	0	0	1	0	0	0	0	0	0	1	0	2
Canidae (Dogs)	0	2	0	0	0	0	0	0	0	0	0	2
Macropodidae (Kangaroo)	0	1	0	1	0	0	0	0	0	0	0	2
Camelidae (Llamas)	0	0	0	2	0	0	0	0	0	0	0	2
Erinaceidae (Hedgehog)	0	0	0	0	1	0	0	1	0	0	0	2
Arctictis (Binturong)	0	0	0	0	0	0	0	0	1	1	0	2
Mustelidae (Badger)	0	0	0	0	0	0	0	0	0	2	0	2
Petauristidae (Squirrels)	0	1	0	0	0	0	0	0	0	0	0	1
Pteropodidae (Fruit Bat)	0	0	1	0	0	0	0	0	0	0	0	1
Cuniculidae (Paca)	0	0	0	1	0	0	0	0	0	0	0	1
Dasypodidae (Armadillo)	0	0	0	0	0	1	0	0	0	0	0	1
Caviidae (Cavy)	0	0	0	0	0	0	0	1	0	0	0	1

Table D (page 288) shows the distribution of tuberculosis amongst the families of Birds.

Graph 8 illustrates the incidence of deaths due to disorders of Nutrition and Metabolism, i. e., Rickets and allied diseases; it shows the decline of these

Graph 8:



disorders among Mammals since the institution of a more varied and carefully selected diet in 1928.

TABLE D.—Incidence of Tuberculosis amongst Birds, 1928-1938.

	Years.											Totals.
	1928.	1929.	1930.	1931.	1932.	1933.	1934.	1935.	1936.	1937.	1938.	
Phasianidæ	12	8	5	2	8	6	4	4	3	9	8	69
Anseres	2	3	7	2	3	2	1	5	1	3	1	30
Gallinæ	9	1	4	0	0	0	0	0	1	0	0	15
Psittaciformes	2	4	3	3	1	1	2	0	1	1	1	19
Columbæ	8	2	1	3	3	0	0	1	0	1	1	20
Passeriformes	6	3	3	0	0	0	0	2	1	1	1	17
Ardeiformes	0	2	1	0	0	2	0	0	0	3	0	8
Rallidæ	5	0	0	0	1	1	2	0	0	0	3	12
Accipitres	1	1	1	0	0	0	0	0	0	1	3	7
Fringillidæ	0	0	0	0	3	1	0	0	0	2	0	6
Strigiformes	1	0	0	1	0	1	0	1	0	0	1	5
Baleariciformes	0	1	0	2	0	0	0	1	0	0	0	4
Fulicariæ	3	0	0	0	0	0	0	0	0	0	0	3
Limicolæ	2	0	0	0	0	0	0	0	0	0	0	2
Bucerotidæ	0	0	0	0	0	0	1	0	1	0	0	2
Musophagidæ	0	0	0	0	0	0	2	0	1	0	0	3
Sphenisciformes	1	0	0	0	0	0	0	1	1	0	0	3
Herodias	1	0	0	0	0	0	0	0	0	0	0	1
Odontoglossæ	1	0	0	0	0	0	0	0	0	0	0	1
Alectorides	1	0	0	0	0	0	0	0	0	0	0	1
Impennes	1	0	0	0	0	0	0	0	0	0	0	1
Coccygiformes	0	1	0	0	0	0	0	0	0	0	0	1
Coraciiformes	0	1	0	0	0	0	0	0	0	0	0	1
Turniciformes	0	1	0	0	0	0	0	0	0	0	0	1
Rheiformes	0	1	0	0	0	0	0	0	0	0	0	1
Piciformes	0	0	1	0	0	0	0	0	0	0	0	1
Cursoridæ	0	0	0	1	0	0	0	0	0	0	0	1
Pyrenonotidæ	0	0	0	1	0	0	0	0	0	0	0	1
Laridæ	0	0	0	0	1	0	0	0	0	0	0	1
Cuculidæ	0	0	0	0	0	1	0	0	0	0	0	1
Philepittidæ	0	0	0	0	0	1	0	0	0	0	0	1
Tanagridæ	0	0	0	0	0	1	0	0	0	0	0	1
Upupidæ	0	0	0	0	0	1	0	0	0	0	0	1
Phalacrocoracidæ	0	0	0	0	0	0	1	0	0	0	0	1
Trochilidæ	0	0	0	0	0	0	1	0	0	0	0	1
Charadriiformes	4	0	0	0	0	0	0	1	0	0	0	5
Struthioniformes	0	0	0	0	0	0	0	0	1	0	0	1

During the succeeding eight years, synthetic vitamin preparations in one form or another were administered to susceptible animals. In 1936 natural vitamins were added or substituted—but it is too early to express any opinion on the effect of this change.

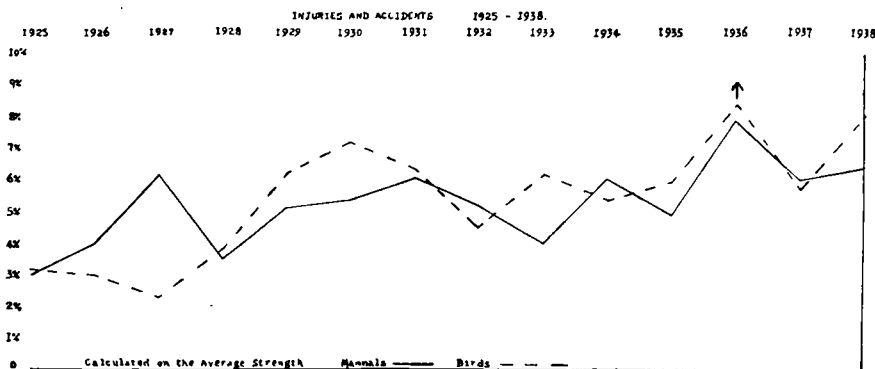
In Table E.—The distribution of Rickety diseases amongst Mammals is shown. Note their prevalence amongst Platyrrhine Primates, which do not respond to the ordinary antirachitic treatment.

TABLE E.—Incidence of Disorders of Nutrition and Metabolism (Rickets, etc.) amongst Mammals, 1928–1938.

	Years.							Totals.
	1928-32.	1933.	1934.	1935.	1936.	1937.	1938.	
Platyrrhini (New World Primates).....	28	7	3	6	7	3	0	72
Platyrrhini (Hapalidæ, Marmosets).....	0	0	5	5	6	1	1	
Catarrhini (Old World Primates).....	20	4	1	1	3	0	5	34
Viverridæ (Civets, Gennets, Mongoose, etc.)	17	4	3	1	3	1	2	31
Canidæ, Canis and Procyonoides.....	9	4	0	2	6	2	1	24
Sciuridæ (Squirrels).....	7	1	0	1	2	3	0	14
Muridæ (Gerbils, Rats, Mice).....	0	1	1	0	2	2	3	9
Erinaceidæ (Hedgehogs).....	8	1	0	0	0	1	0	10
Bovidæ (Antelope).....	1	0	0	0	2	0	1	4
Felidæ (Lion Cubs, Serval).....	0	0	0	0	0	1	1	2
Hystrioidæ (Porcupine).....	0	1	1	1	0	0	1	4
Choleopodidæ (Sloth).....	1	0	0	0	0	2	0	3
Marsupialia (Didelphis, Opossum).....	0	0	0	0	0	3	0	3
Cervidæ (Muntjac).....	1	1	0	0	0	0	0	2
Mustelidæ (Badger).....	0	0	0	0	0	0	2	2
Rodentia (Hamsters, etc.).....	1	0	0	0	0	0	1	2
Equidæ (Zebra).....	1	0	0	0	0	0	0	1
Chiroptera (Bats).....	0	0	0	1	0	0	0	1
Ailurus (Panda).....	0	0	0	0	0	1	0	1
Camelidæ (Camel).....	0	0	0	0	0	0	1	1
Hippopotamidæ.....	1	0	0	0	0	0	0	1

Graph 9 shows a progressive rise from 1925 to 1928 in the losses of Mammals and Birds from Injuries and Accidents, largely due to the pugnacity

Graph 9.



of male creatures, which, under conditions of captivity, kill each other, their pregnant females, and their young.

The mortality is higher than that from any disease.